



ENGINEERING SMART CITIES

INDIANA INNOVATIONS IN ENGINEERING

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STRATEGIC PRIORITIES



Advocacy | advocate for legislation, regulation and policies that promote and protect the business interests of engineering companies in Indiana.



Business Resources and Education | serve as the critical resource for the development of business strategy, connectivity, and education for ACEC member firms.



Leadership Development | develop and diversify leaders for ACEC Indiana so that the organization and member firms will flourish and sustain its prominence in serving the industry.



Workforce Development | attract talent for the consulting industry so that we develop a diverse, sustainable workforce.

Civil Engineering

Civil Engineers design elements of civil society, our natural and physically built environment, including roads, bridges, airports, buildings and waterways.



Your Day

brought to you by engineering



Get Ready

Use your bathroom
(sanitary sewers)

Make your coffee
(clean drinking water)



Go to Work

Drive your car (roads,
bridges, traffic signals)

Enter your office
(structural)



During the Day

Use your computer
(computer, systems)

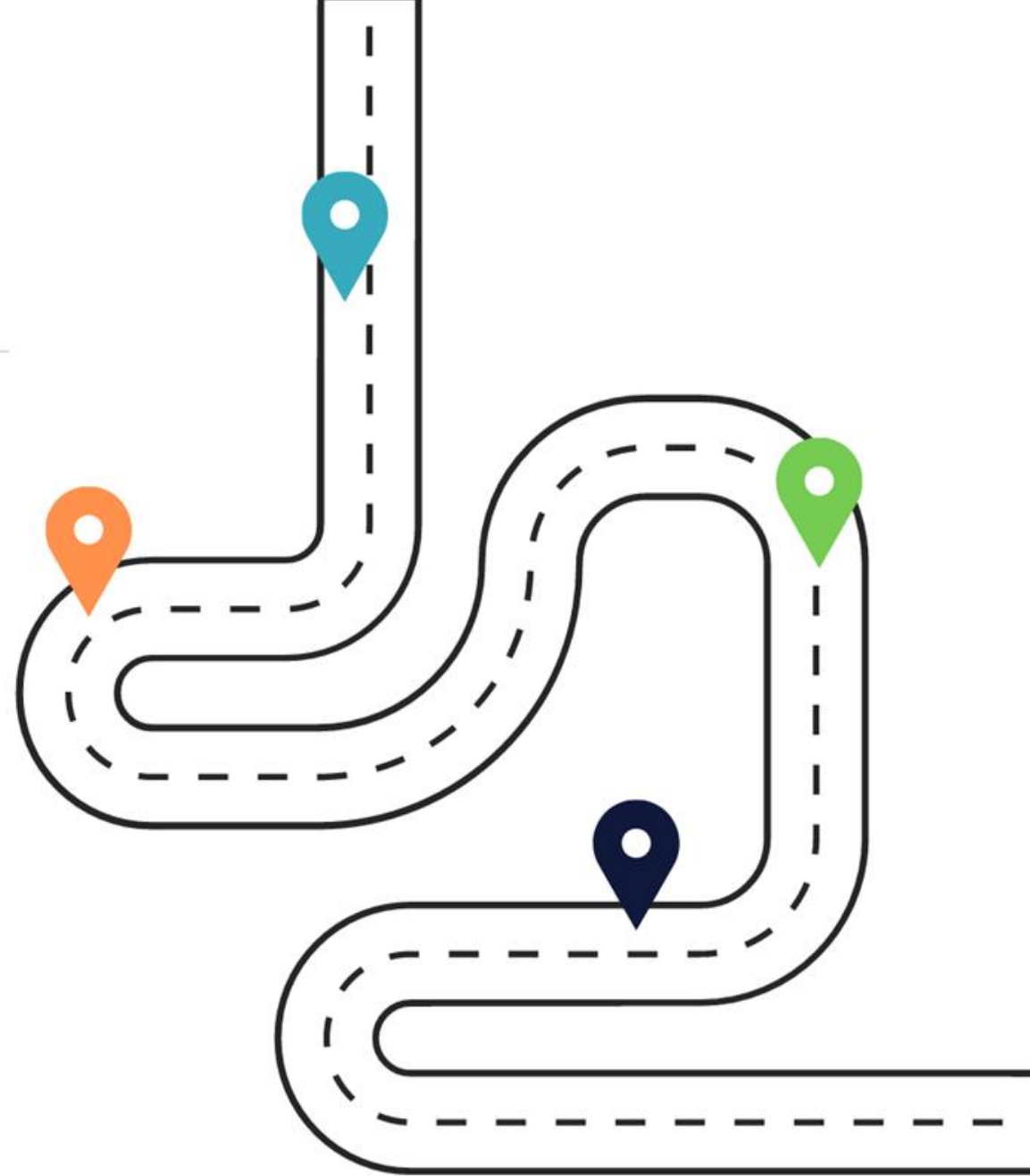
Try new restaurant
(surveying, mapping)



At Home

Use AC/heat
(mechanical, electrical)

Make travel plans
(airports)



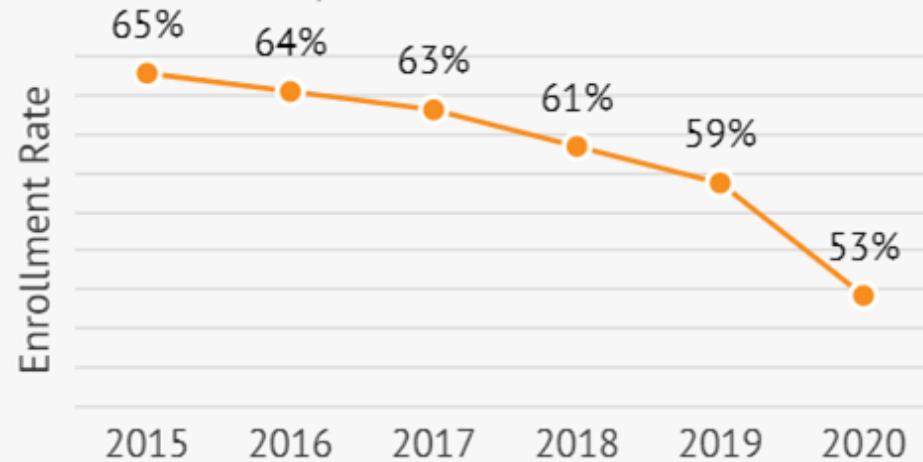


Industry & Job Demand

INDIANA TALENT CHALLENGES

COLLEGE-GOING DECLINE

The rate of high school students enrolling in college continues to drop.



Retention of Grads (attraction v. retention):

 **14th**
in attracting
people to come
to Indiana for college

40th
in
retaining
college graduates 

INDIANA OPPORTUNITY IN INFRASTRUCTURE

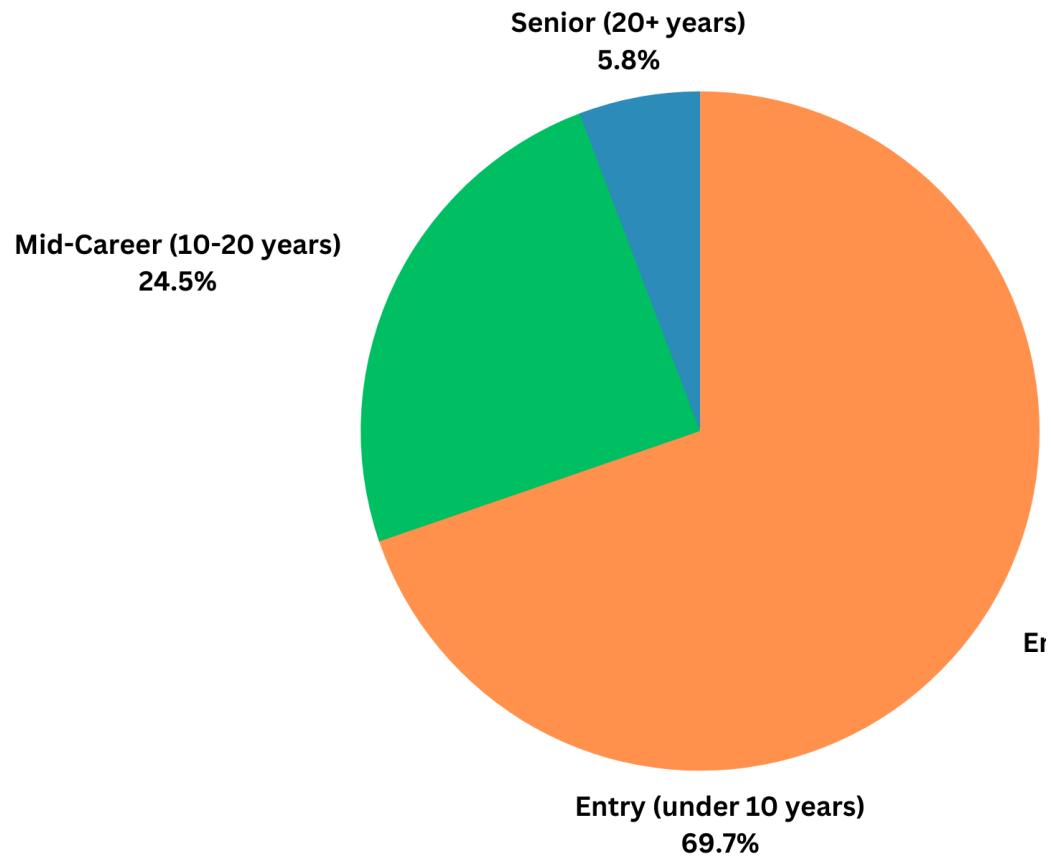
- Civil engineering and civil construction has strong **job security in Indiana.**
- **Historic investments** in infrastructure. federal, state and local governments, as well as private investment.
- INDOT will deliver ~1,200 new construction projects in 2023, investing more than **\$2.5 billion in infrastructure improvements** this year alone (combined with preventative maintenance activities).

#1 Indiana ranking in infrastructure

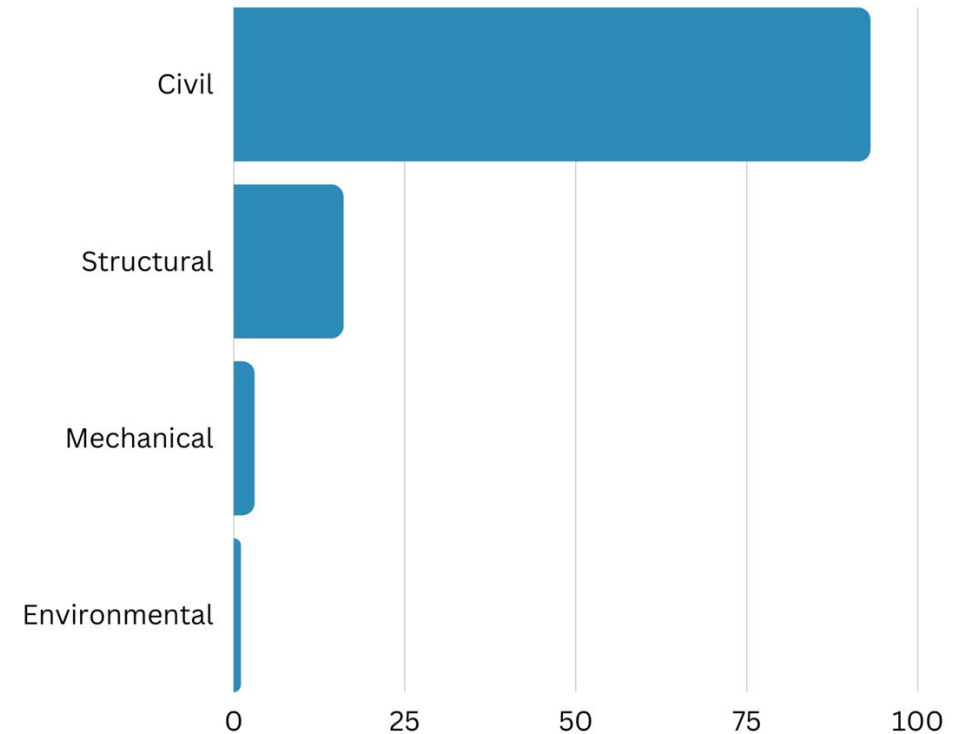
in CNBC's annual "Top States for Business" Report in 2016, 2019 and 2022, and among top five for nearly a decade.

SOUGHT BY INDIANA FIRMS HIRING IN 2022

Experience Level Demand



Discipline Demand





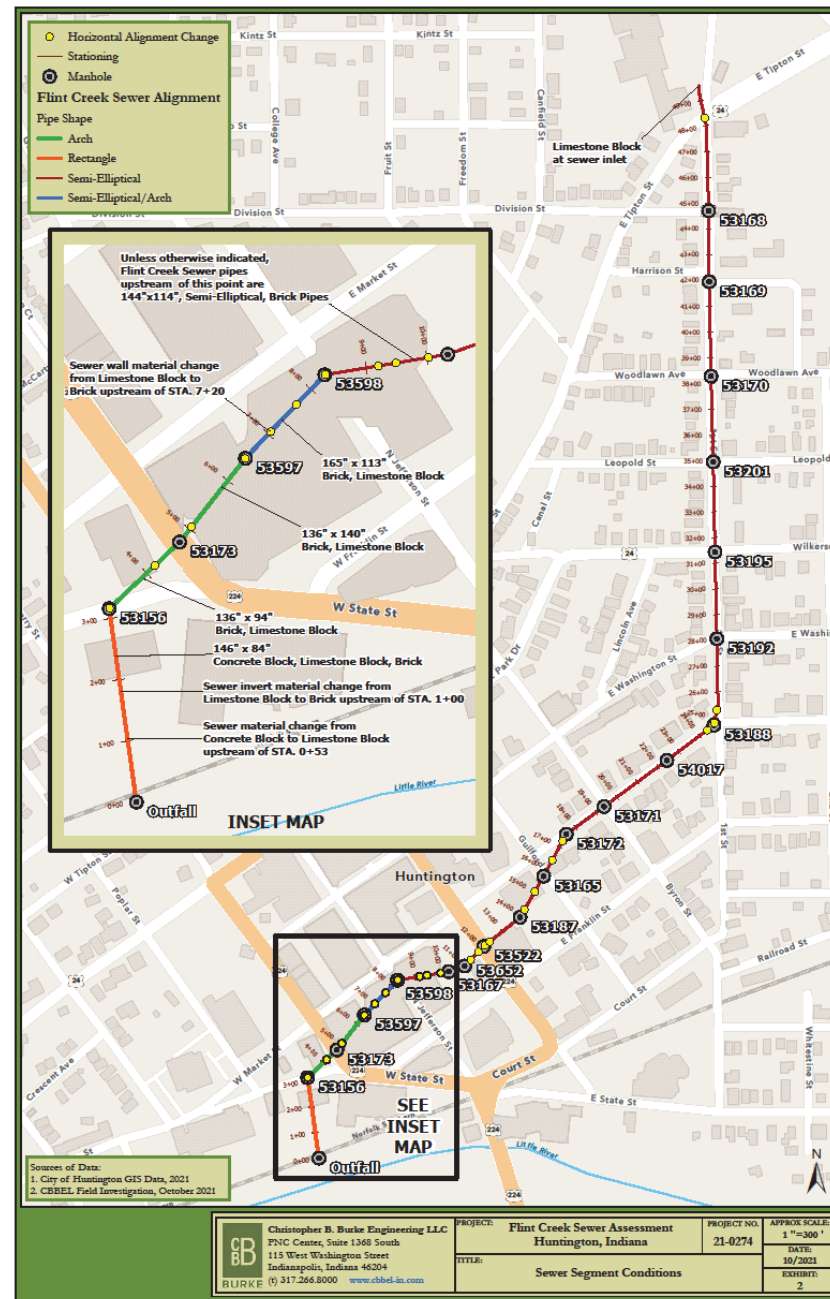
Resources & Environment

RESILIENCY AND ADAPTATION

- Asset Management
- Climate Change
- Regional Planning
- Natural Drainage Systems
- Emergency Planning
- Sustainability

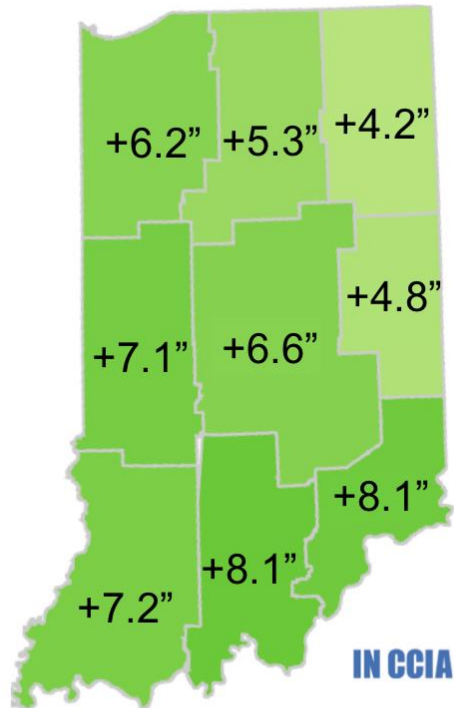
ASSET MANAGEMENT

- Water Distribution System
- Water Treatment and Storage
- Sanitary or Combined Sewer Collection System
- Wastewater Treatment
- Storm Sewer Collection and Treatment
- Natural Drainage Systems
- Flood Control Systems
- Sidewalks and Trails
- Roads
- Traffic signals
- Street Lighting
- Trees

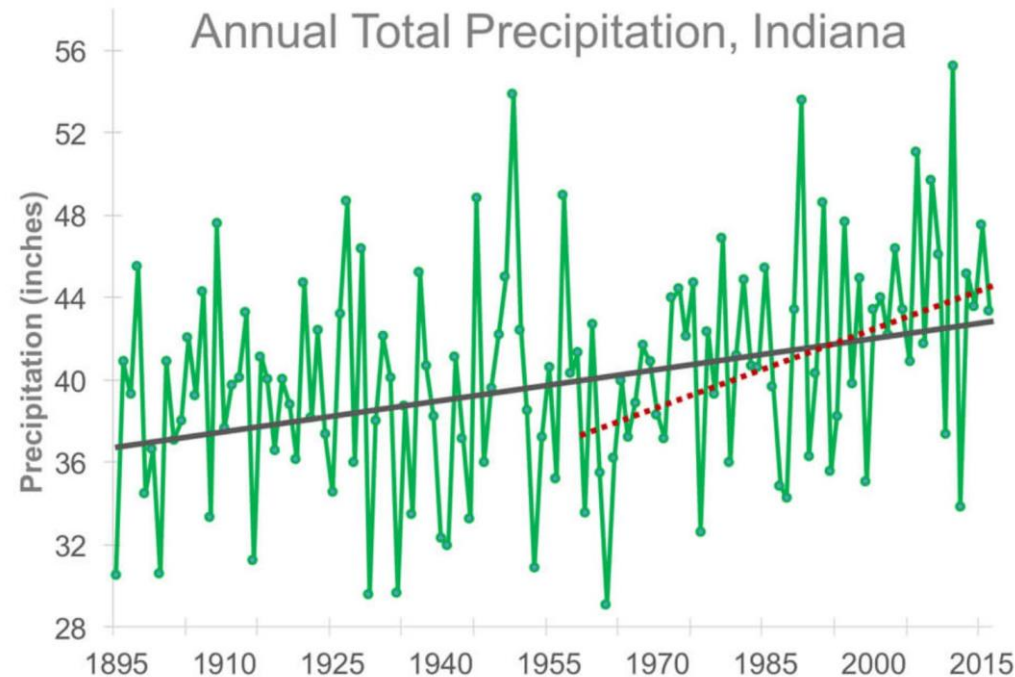


CLIMATE CHANGE

Change In Annual Average Precipitation 1895-2019



Change in annual average precipitation
based on linear trend between 1895 to 2019

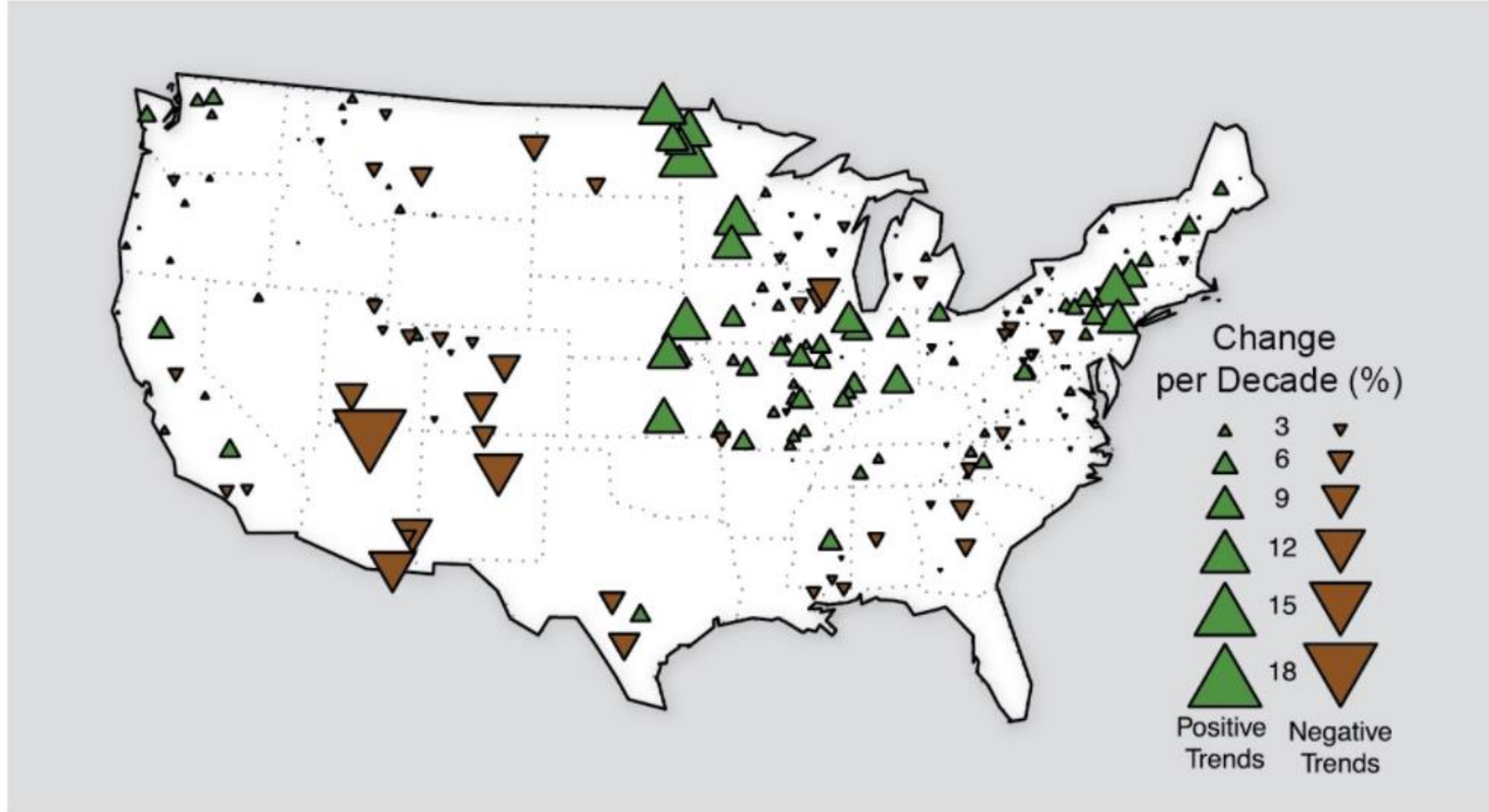


Source: Indiana Climate Change Impacts Assessment. Purdue University (2019)

Indiana 2050...

- 1. Total Annual Precipitation:** *expected to increase 6-8%*
- 2. Seasonal Precipitation:** *expected to increase 25% in winter and 20% in spring*
- 3. Type of Precipitation:** *rain is expected to replace snowfall*

Trends in Flood Magnitude



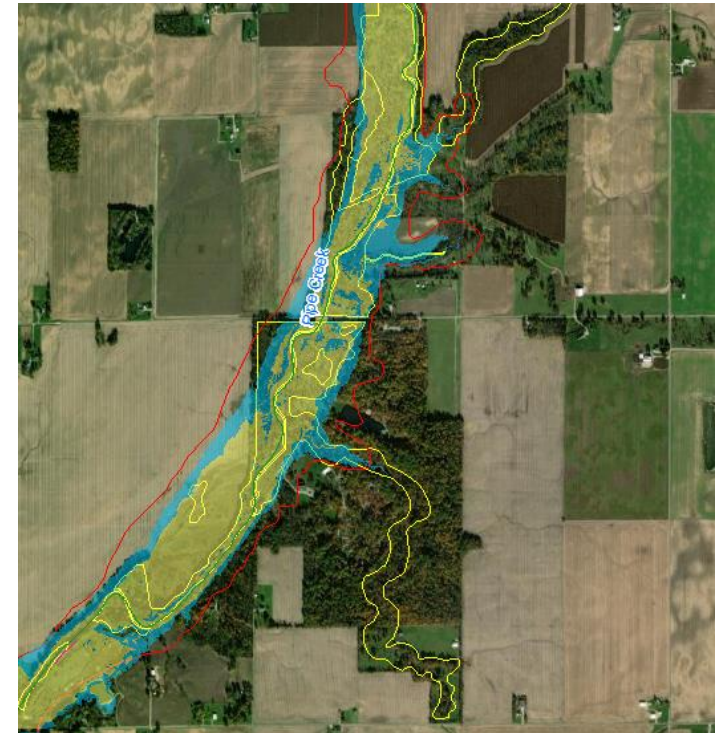
nca2014.globalchange.gov

FLOODPLAIN CONNECTIVITY

How often does a stream access its floodplain? How “easy” is it?

Connectivity has local and far-reaching benefits

- Flood control: increased storage -> decreased flooding/impacts downstream
- Erosion control: flow and energy are dissipated in overbanks
- (Re)Hydration of floodplains and wetlands
 - Ecological/habitat benefits
 - Water quality improvements
 - Groundwater recharge
 - Recreation

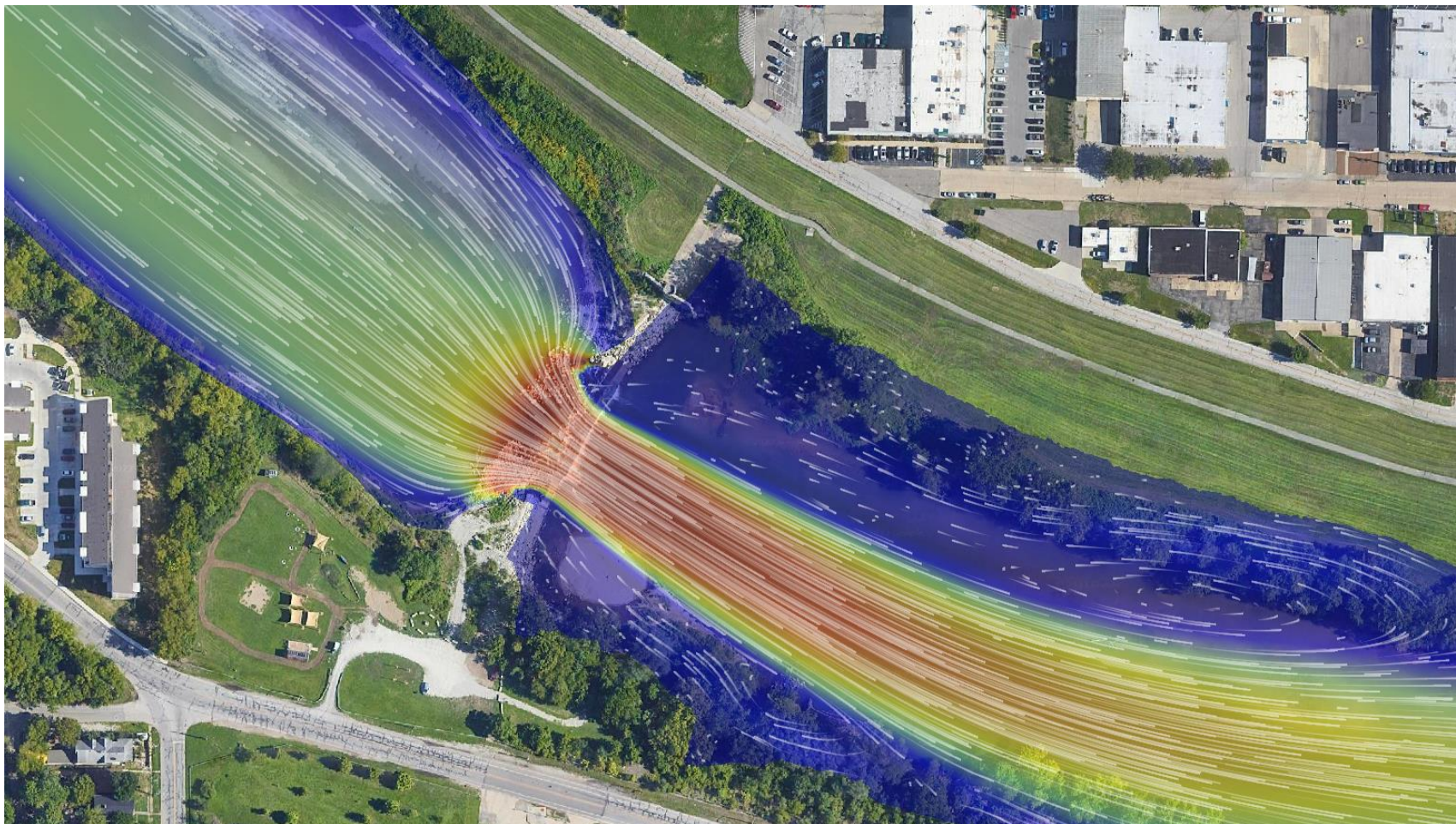


FLOODPLAIN CONNECTIVITY MAPPING TOOL

Urban and Rural Uses



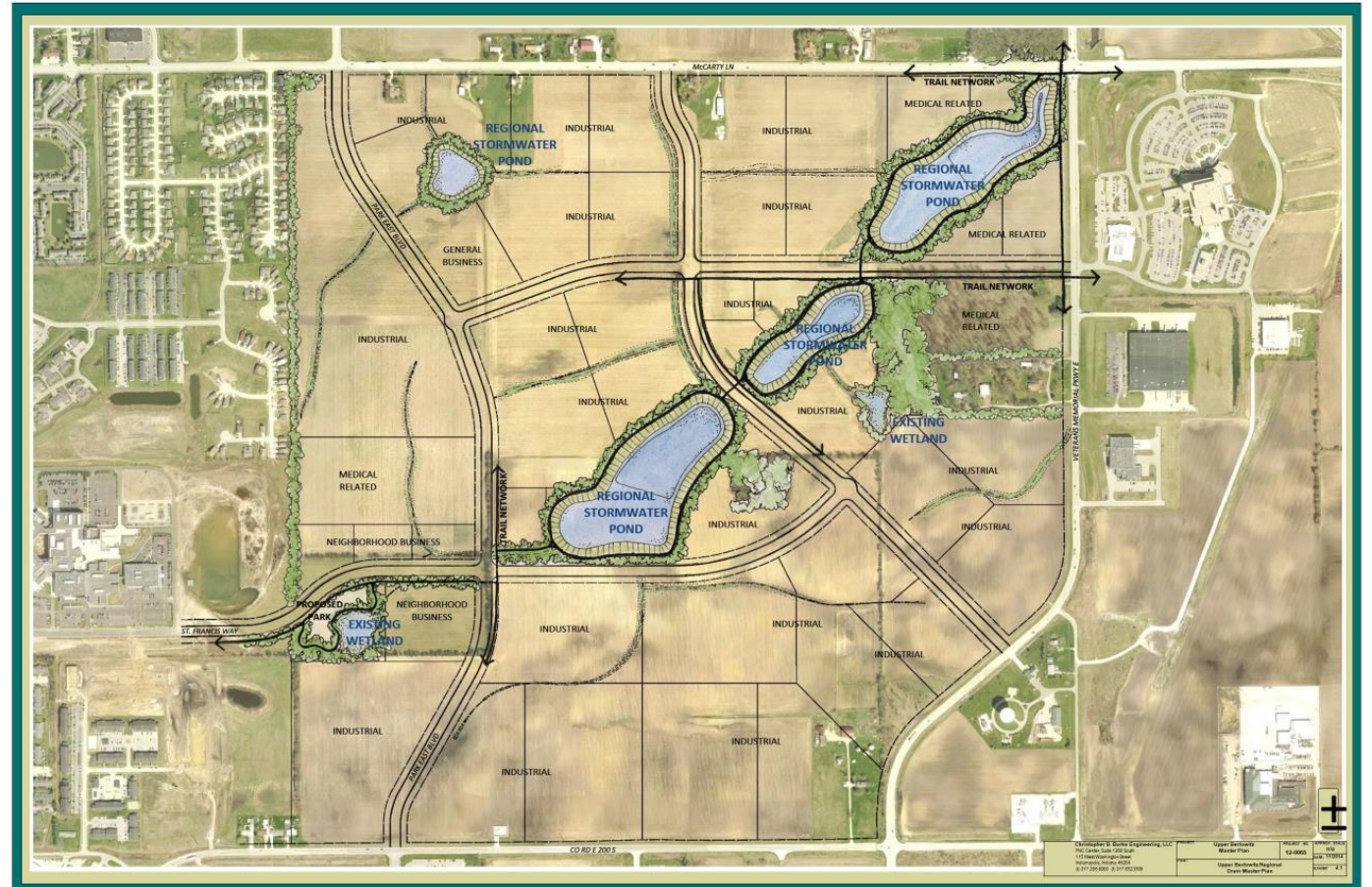
HYDROLOGIC AND HYDRAULIC MODELING



REGIONAL PLANNING – STORMWATER

Upper Berlowitz Regulated Drain

- 600 Acres of 4 sq mile watershed
- Plan completed in 2014
- Pilot channel project 2019

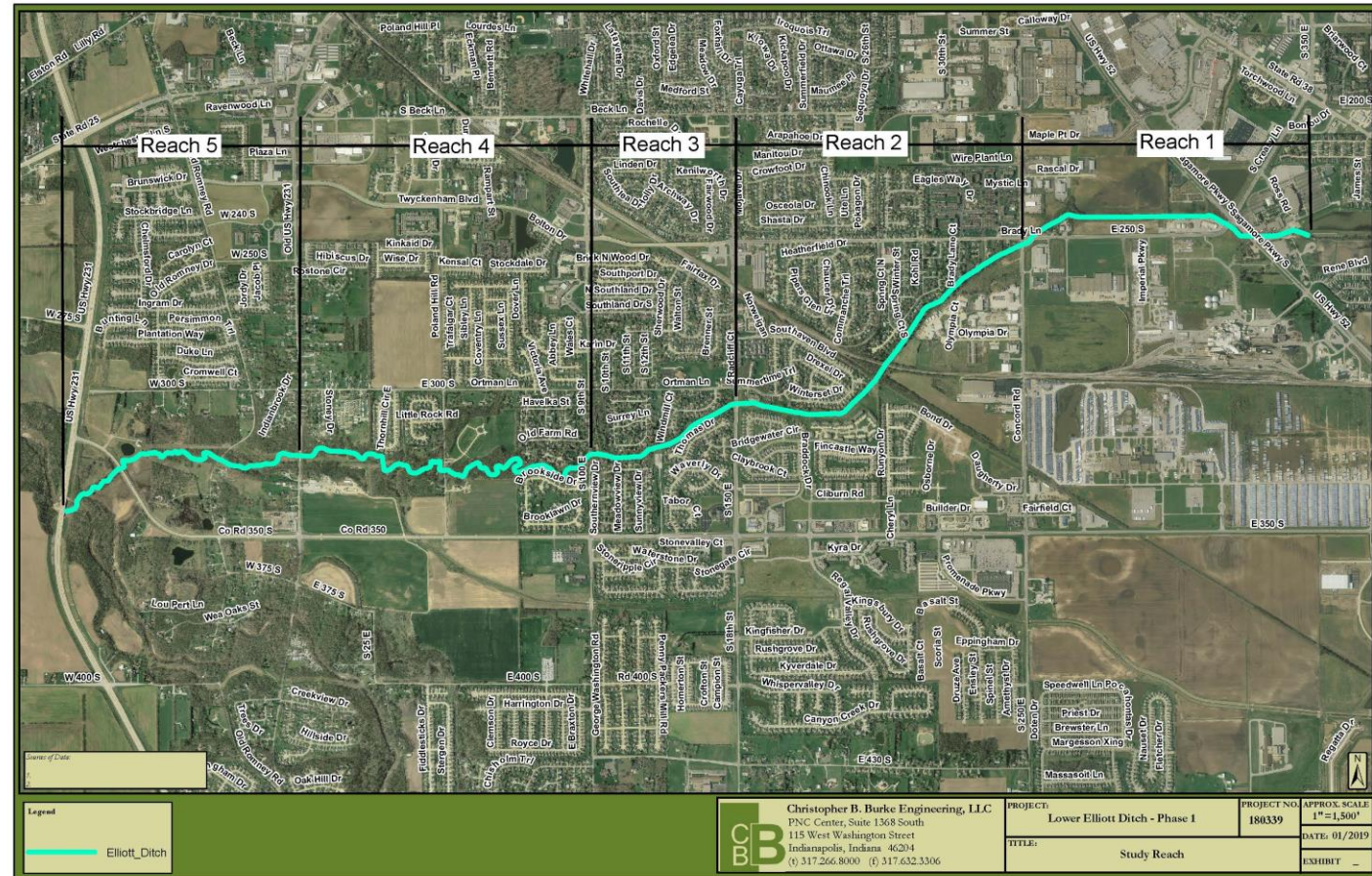




MULTI-JURISDICTIONAL

Elliott Ditch

- Urban Stream
- 19 sq mi drainage area
- Tippecanoe County
- City of Lafayette



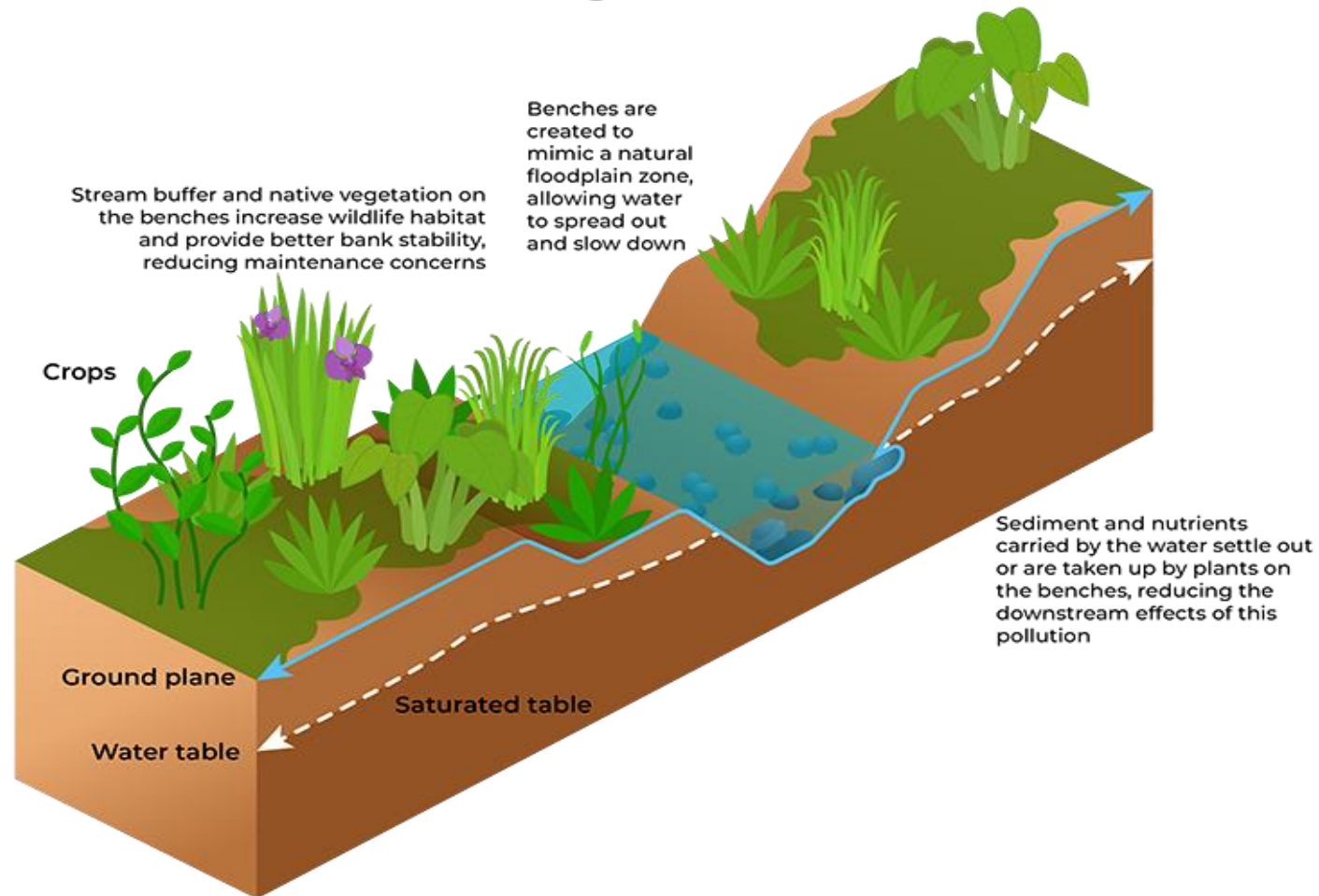


DISCONNECTED FLOODPLAIN



NATURALIZING STRATEGIES FOR MAN-MADE DRAINS AND DITCHES

Two-Stage Ditch







CREATING THE VISION



NATURAL DRAINAGE SYSTEMS

Todd's Creek – Purdue University



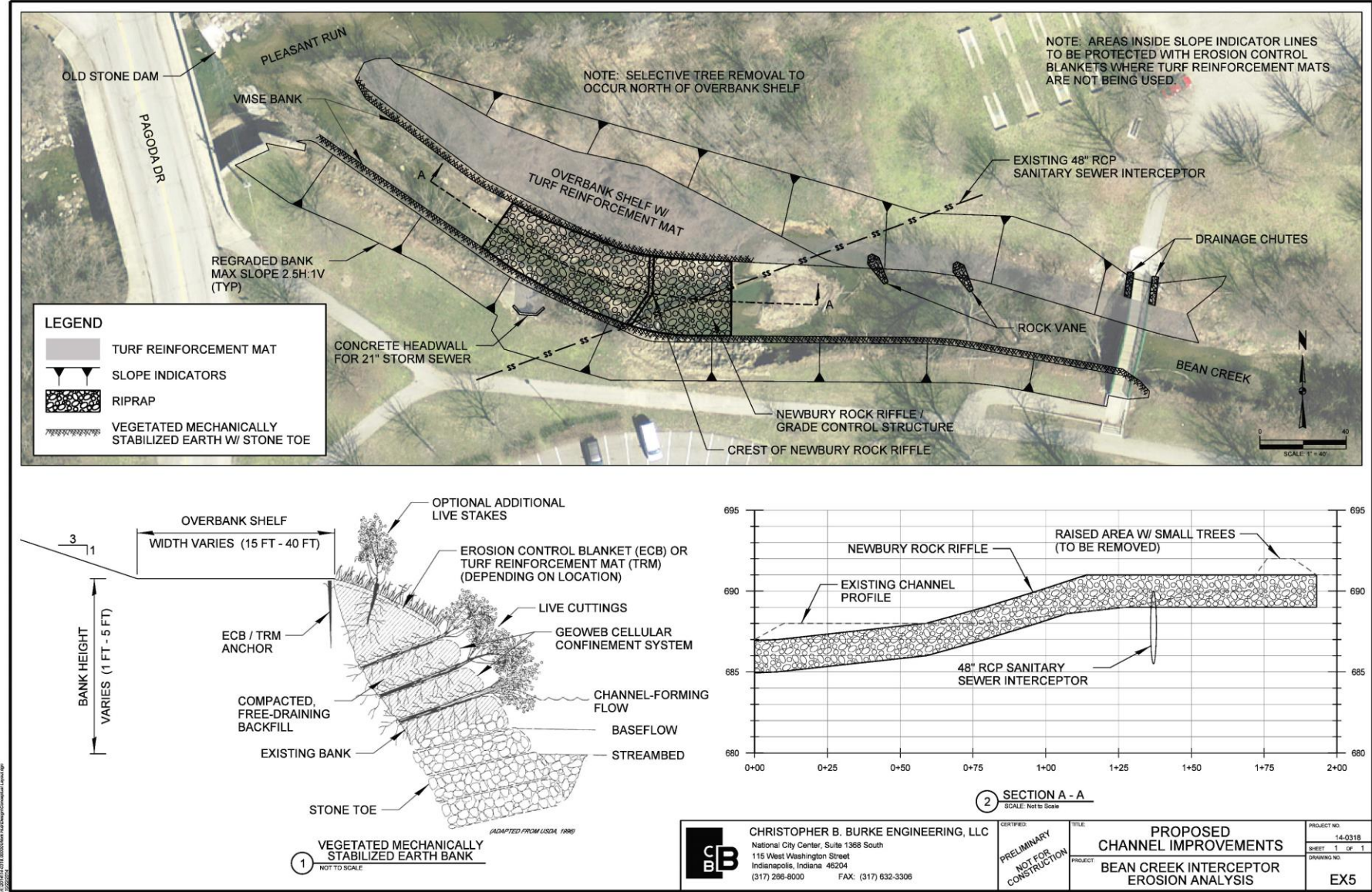


NATURAL DRAINAGE SYSTEMS

Bean Creek - Indianapolis



Conceptual Plan



2017



2020



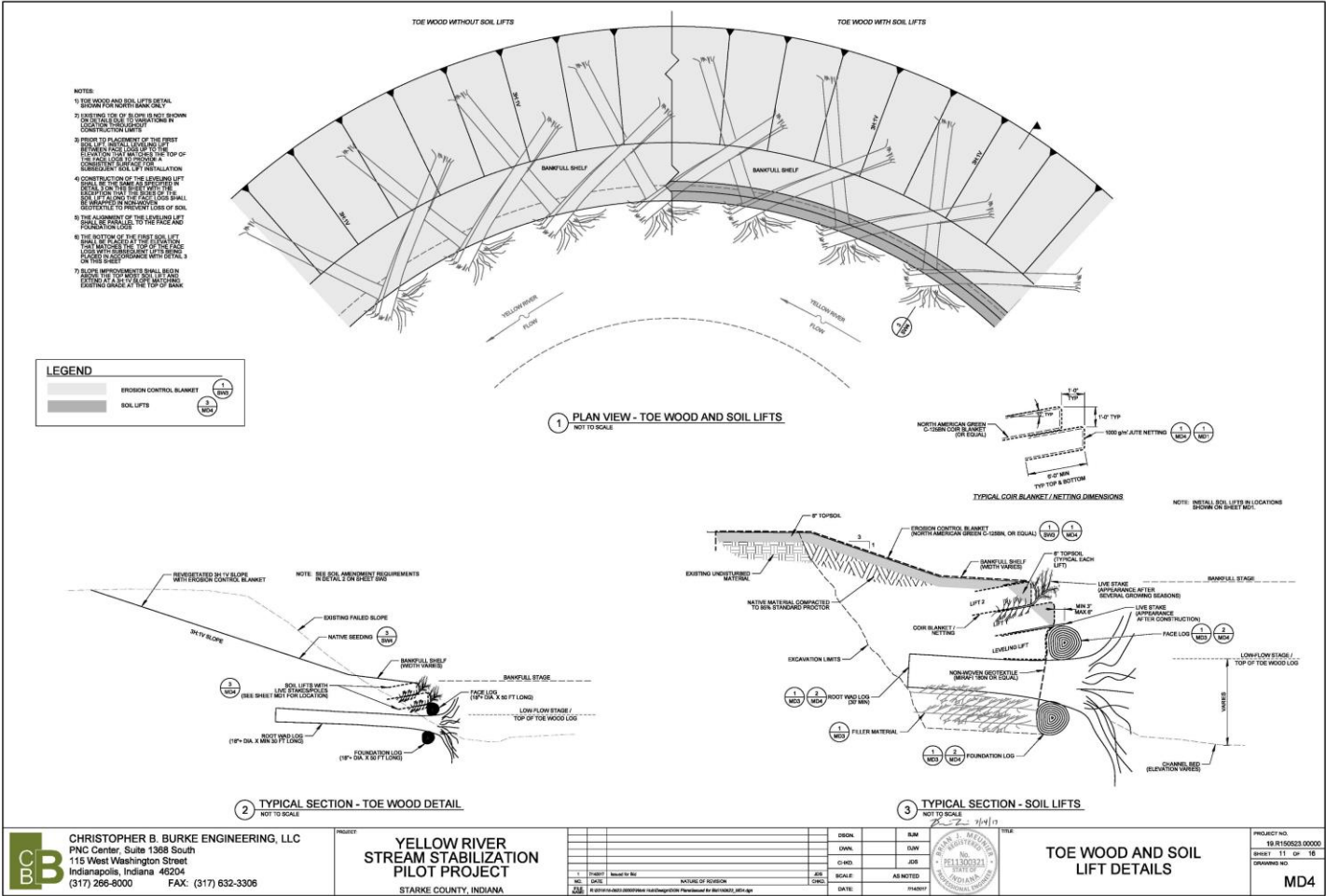
NATURAL DRAINAGE SYSTEMS

Yellow River – Starke County

Before construction



Conceptual Plan



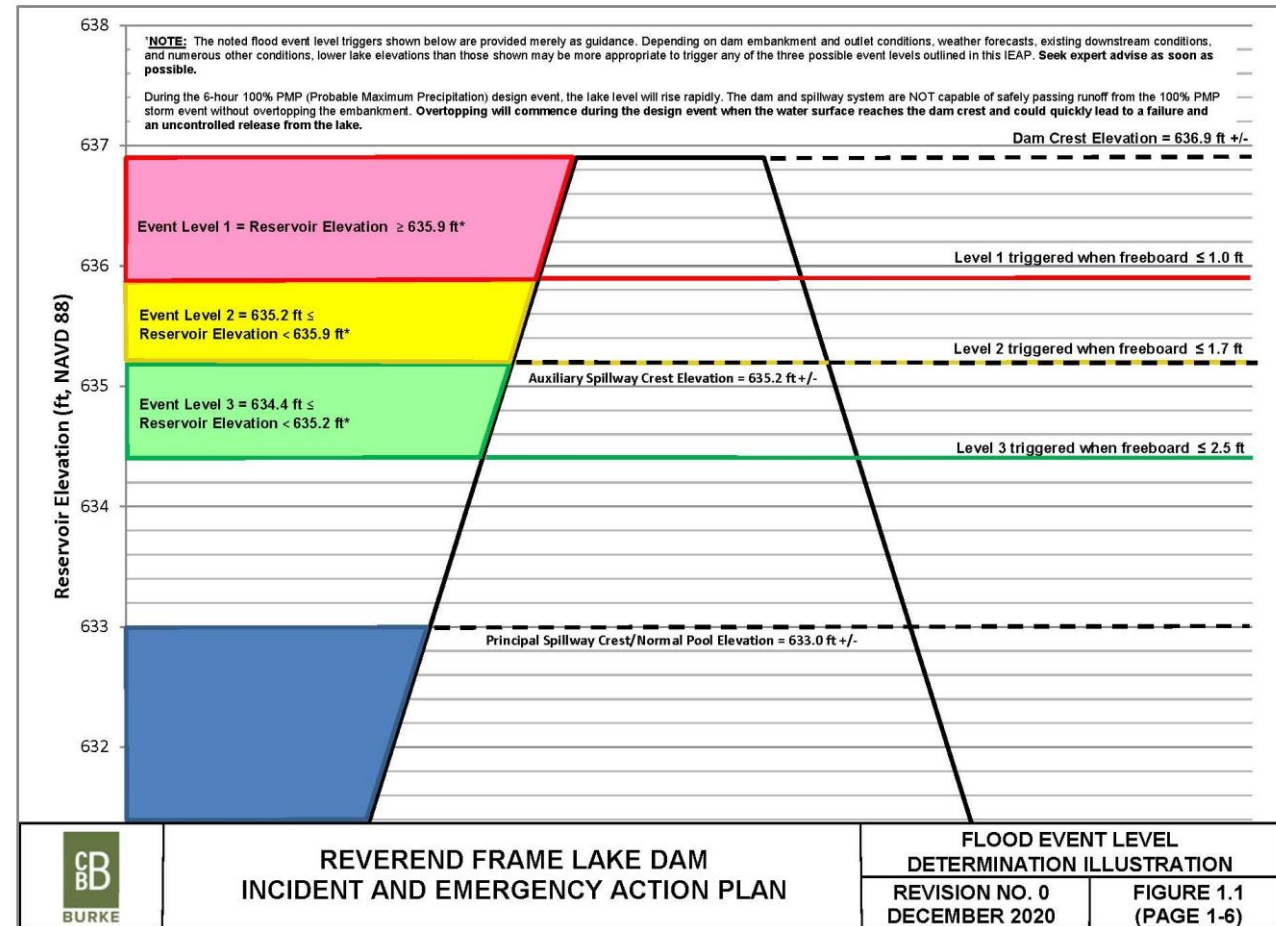
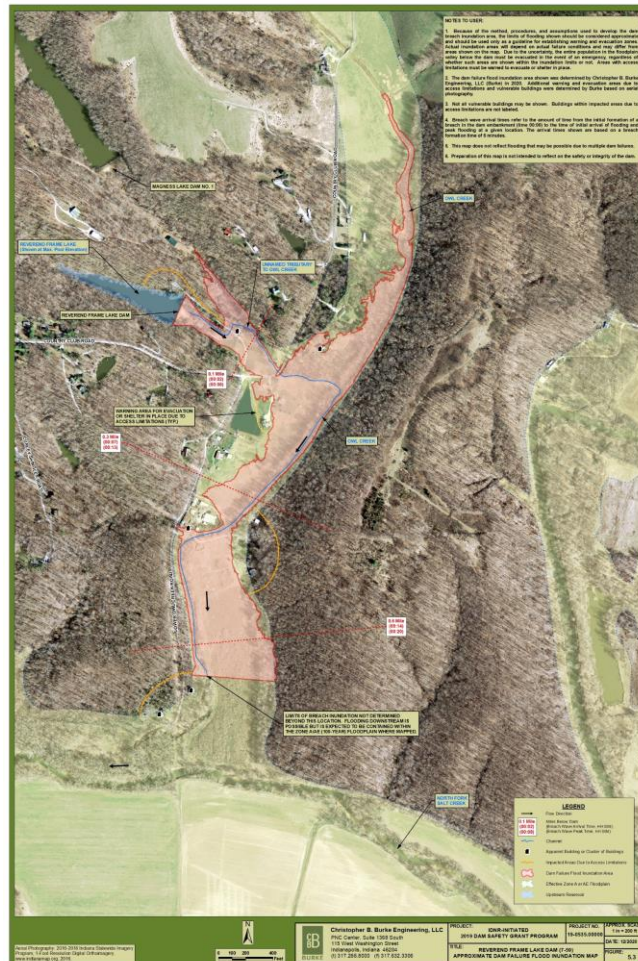
After Construction



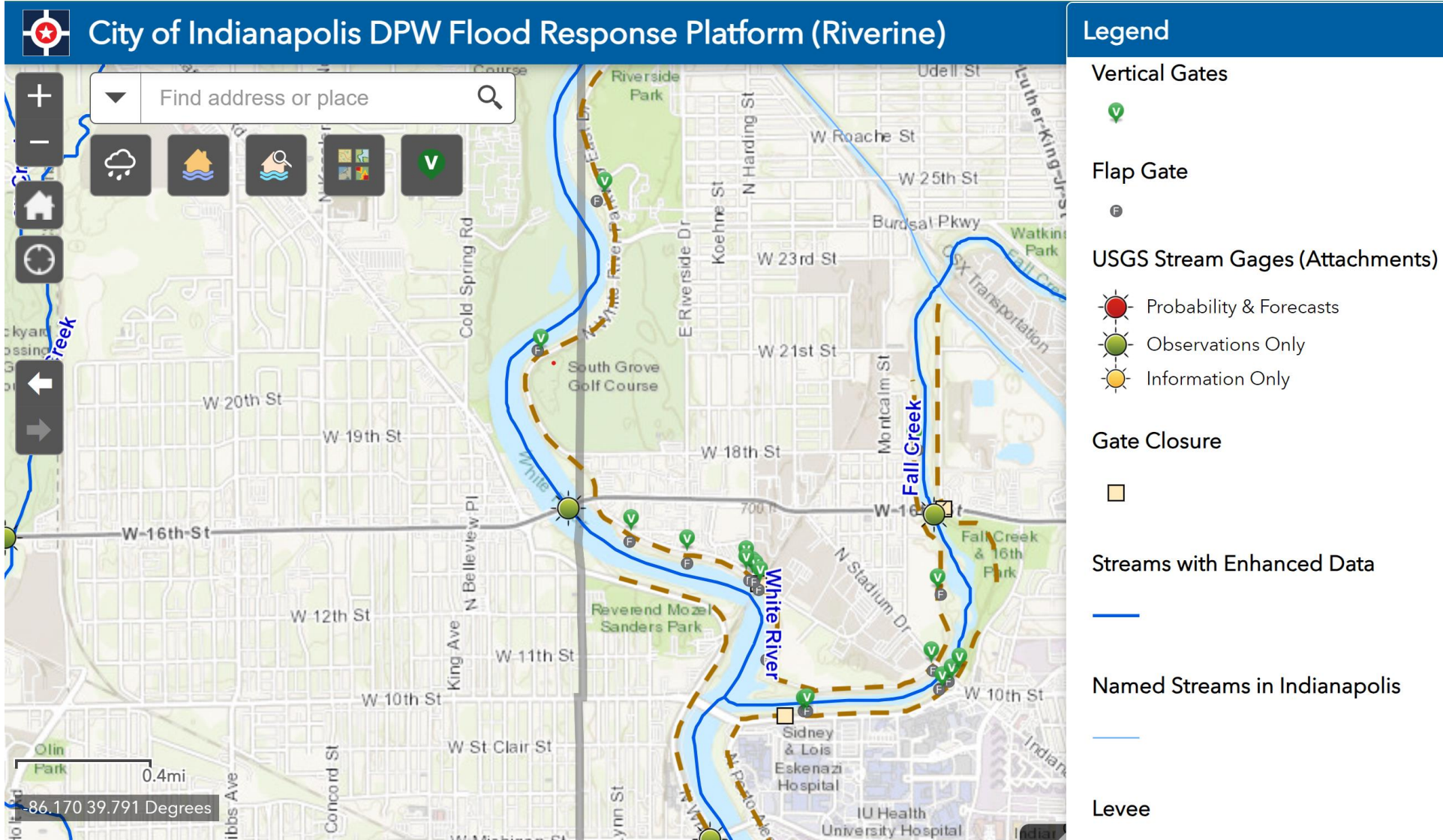
Yellow River – Today



EMERGENCY PLANNING



Flood Response Plan



<https://indygis.maps.arcgis.com/apps/webappviewer/index.html?id=6a8da3f9cd2548f8a1146971a488ea39>

SUSTAINABILITY

- Rain Gardens
- Infiltration
- Wetlands
- Stream restoration
- Water reuse
- Water harvesting
- Native species





Site Development















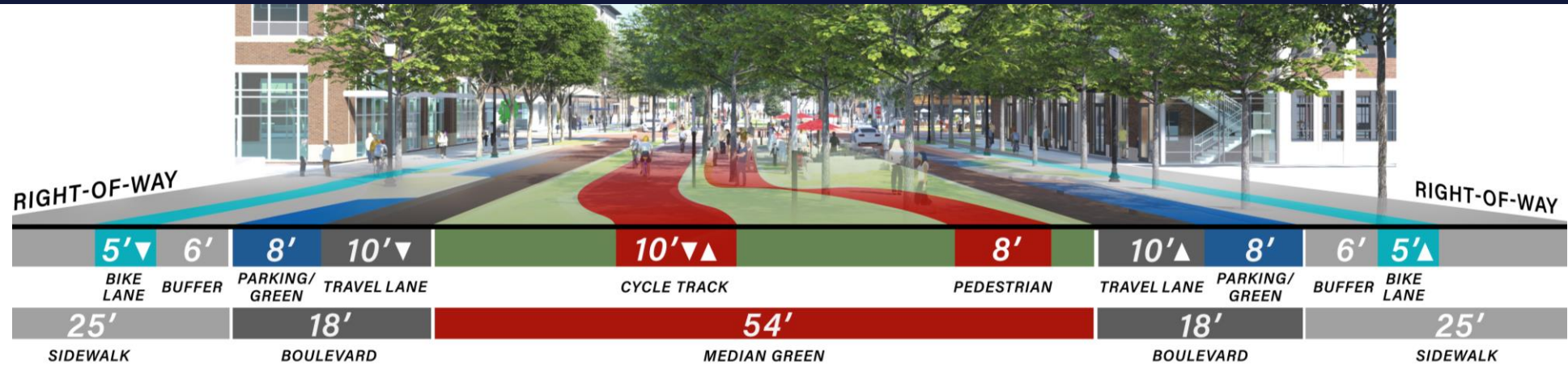
HOW DO WE ENGINEER OUR CITIES?



HOW DO WE ENGINEER OUR CITIES?

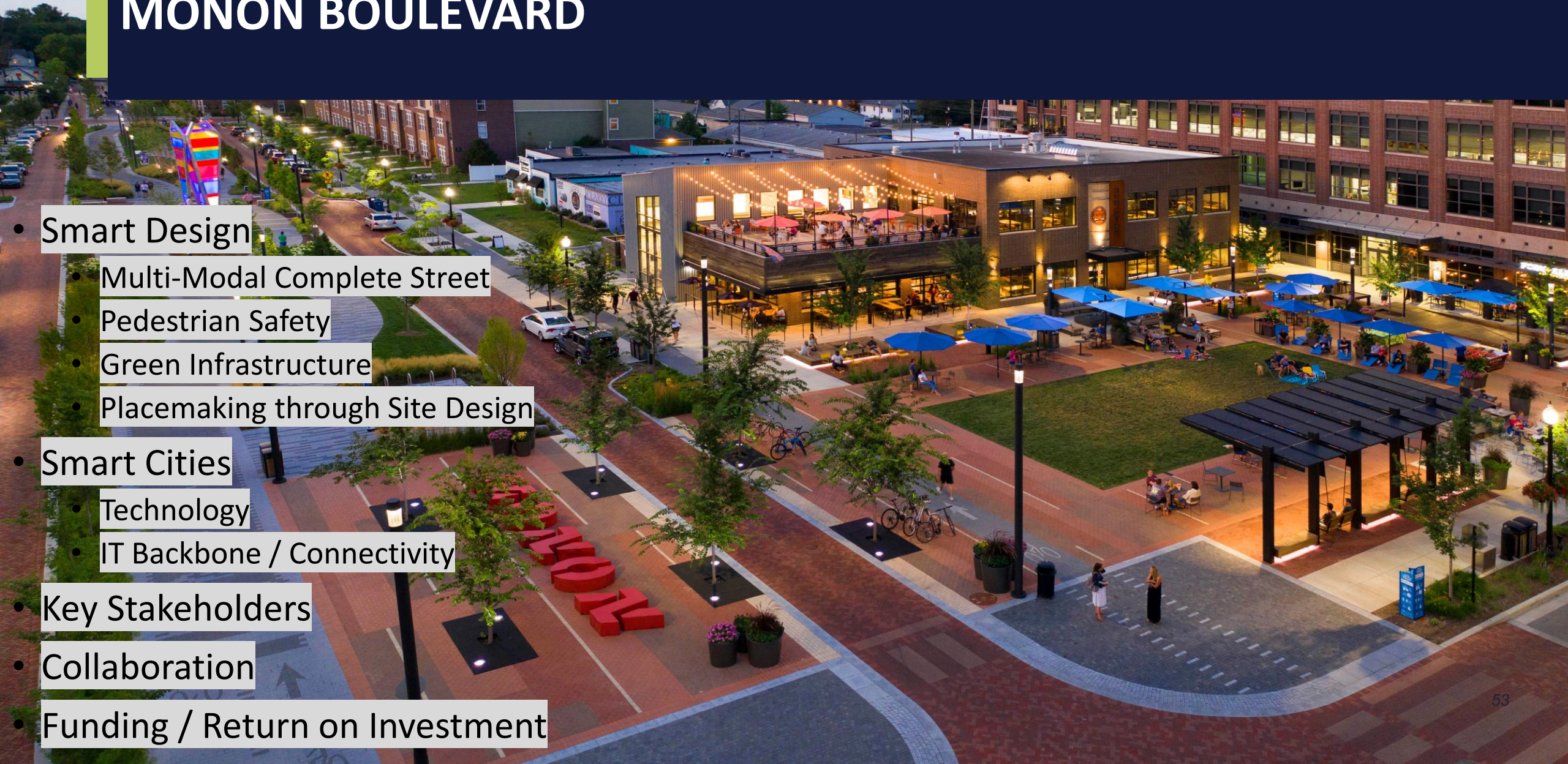


MONON BOULEVARD

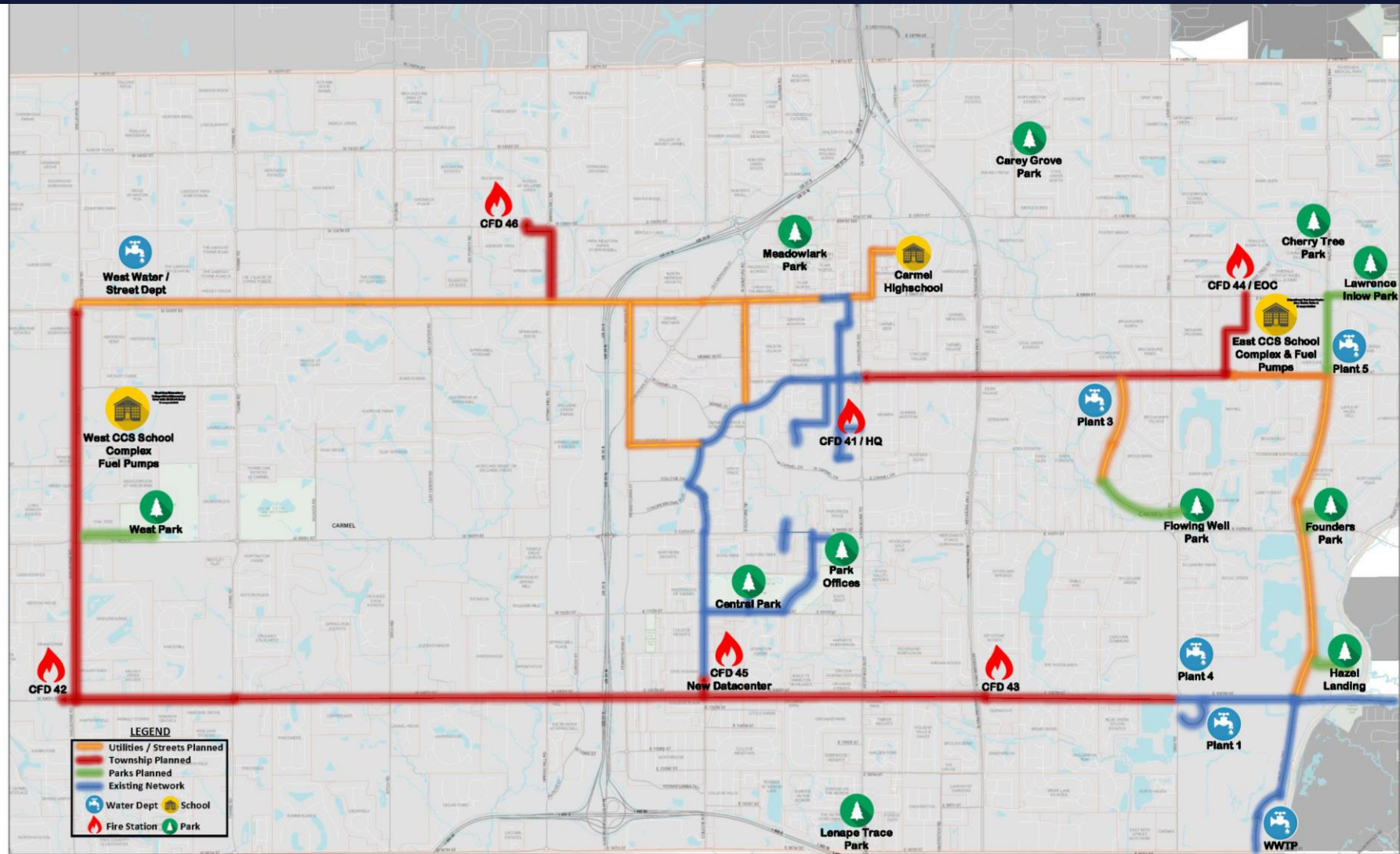


MONON BOULEVARD

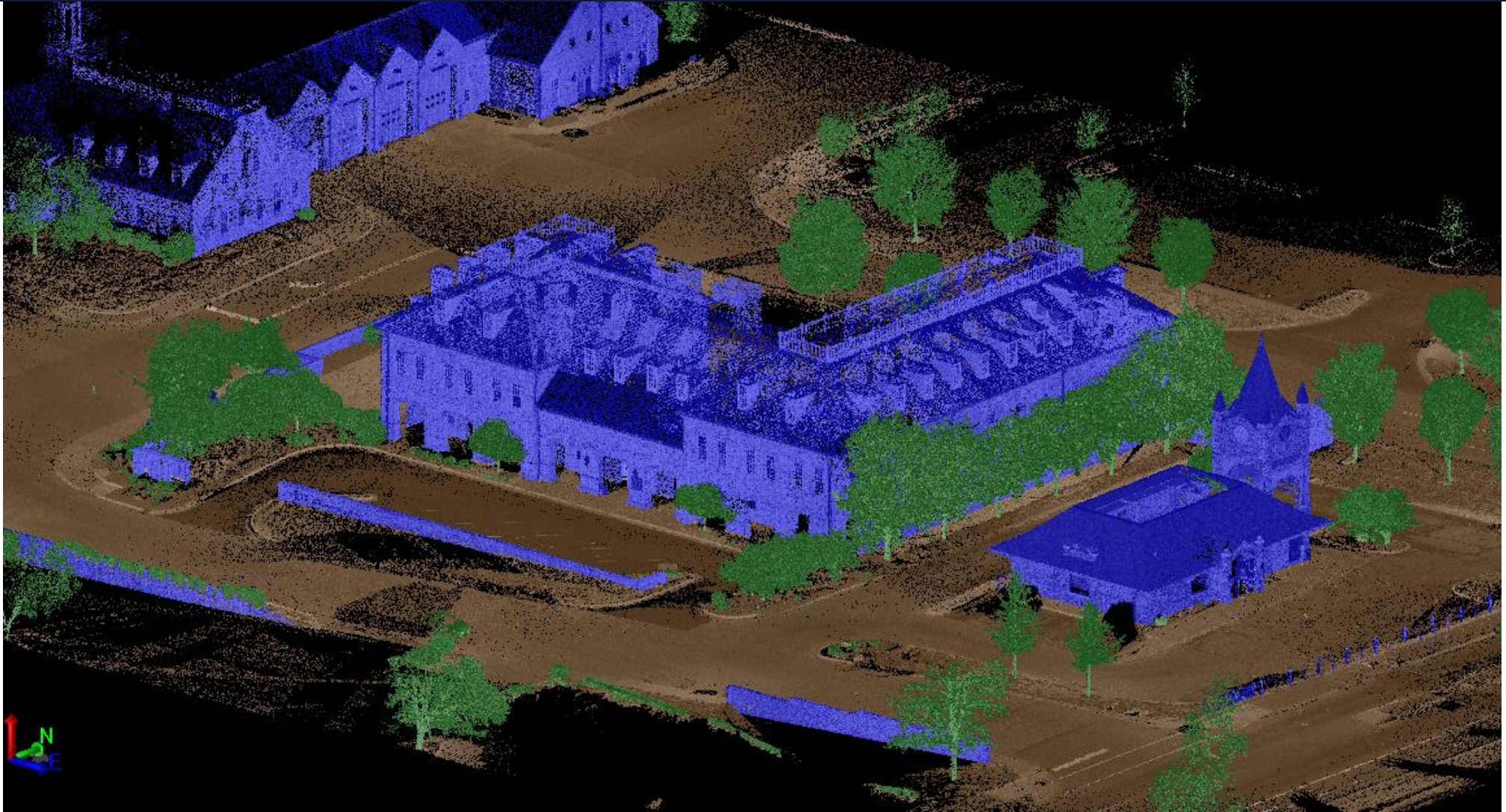
- Smart Design
 - Multi-Modal Complete Street
 - Pedestrian Safety
 - Green Infrastructure
 - Placemaking through Site Design
- Smart Cities
 - Technology
 - IT Backbone / Connectivity
- Key Stakeholders
- Collaboration
- Funding / Return on Investment



TECHNOLOGY



TECHNOLOGY





Transportation

WHAT IS CONNECTED VEHICLE (CV)?

SELF-DRIVING VEHICLES

Self-driving vehicles will have the ability to navigate independently.

DO NOT REQUIRE
ANY DRIVER INPUT



HAVE A 360° VIEW
AT ALL TIMES



Reduce the element of human error in driving, which is the cause in 90% of all accidents today.



However, self-driving vehicles are unlikely to be widely available before 2030.

AUTOMATED VEHICLES

Today, partially automated vehicles are able to perform an increasing number of driving tasks in specific scenarios.

AUTOMATIC PARKING



HIGHWAY PILOT



Advanced driver assistance systems (ADAS) take over safety-critical functions in dangerous situations.

STEERING



BRAKING



CONNECTED VEHICLES

Exchanging safety-critical information between vehicles and infrastructure makes it possible to drive down the number of accidents and casualties.



Using this information it is possible to:

IMPOSE VARIABLE
SPEED LIMITS



HELP AVERT
ACCIDENTS



OPEN OR CLOSE
TRAFFIC LANES



FLAG HAZARDS ON
THE ROAD AHEAD



CV APPLICATIONS

V2I Safety	Environment	Mobility
<ul style="list-style-type: none"> Red Light Violation Warning Curve Speed Warning Stop Sign Gap Assist Spot Weather Impact Warning Reduced Speed/Work Zone Warning Pedestrian in Signalized Crosswalk Warning (Transit) 	<ul style="list-style-type: none"> Eco-Approach and Departure at Signalized Intersections Eco-Traffic Signal Timing Eco-Traffic Signal Priority Connected Eco-Driving Wireless Inductive/Resonance Charging Eco-Lanes Management Eco-Speed Harmonization Eco-Cooperative Adaptive Cruise Control Eco-Traveler Information Eco-Ramp Metering Low Emissions Zone Management AFV Charging / Fueling Information Eco-Smart Parking Dynamic Eco-Routing (light vehicle, transit, freight) Eco-ICM Decision Support System 	<ul style="list-style-type: none"> Advanced Traveler Information System Intelligent Traffic Signal System (I-SIG) Signal Priority (transit, freight) Mobile Accessible Pedestrian Signal System (PED-SIG) Emergency Vehicle Preemption (PREEMPT) Dynamic Speed Harmonization (SPD-HARM) Queue Warning (Q-WARN) Cooperative Adaptive Cruise Control (CACC) Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG) Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE) Emergency Communications and Evacuation (EVAC) Connection Protection (T-CONNECT) Dynamic Transit Operations (T-DISP) Dynamic Ridesharing (D-RIDE) Freight-Specific Dynamic Travel Planning and Performance Drayage Optimization
V2V Safety	Agency Data	Smart Roadside
<ul style="list-style-type: none"> Emergency Electronic Brake Lights (EEBL) Forward Collision Warning (FCW) Intersection Movement Assist (IMA) Left Turn Assist (LTA) Blind Spot/Lane Change Warning (BSW/LCW) Do Not Pass Warning (DNPW) Vehicle Turning Right in Front of Bus Warning (Transit) 	<ul style="list-style-type: none"> Probe-based Pavement Maintenance Probe-enabled Traffic Monitoring Vehicle Classification-based Traffic Studies CV-enabled Turning Movement & Intersection Analysis CV-enabled Origin-Destination Studies Work Zone Traveler Information 	<ul style="list-style-type: none"> Wireless Inspection Smart Truck Parking
Road Weather		
<ul style="list-style-type: none"> Motorist Advisories and Warnings (MAW) Enhanced MDSS Vehicle Data Translator (VDT) Weather Response Traffic Information (WxTINFO) 		

BASIC SAFETY MESSAGES (BSM)

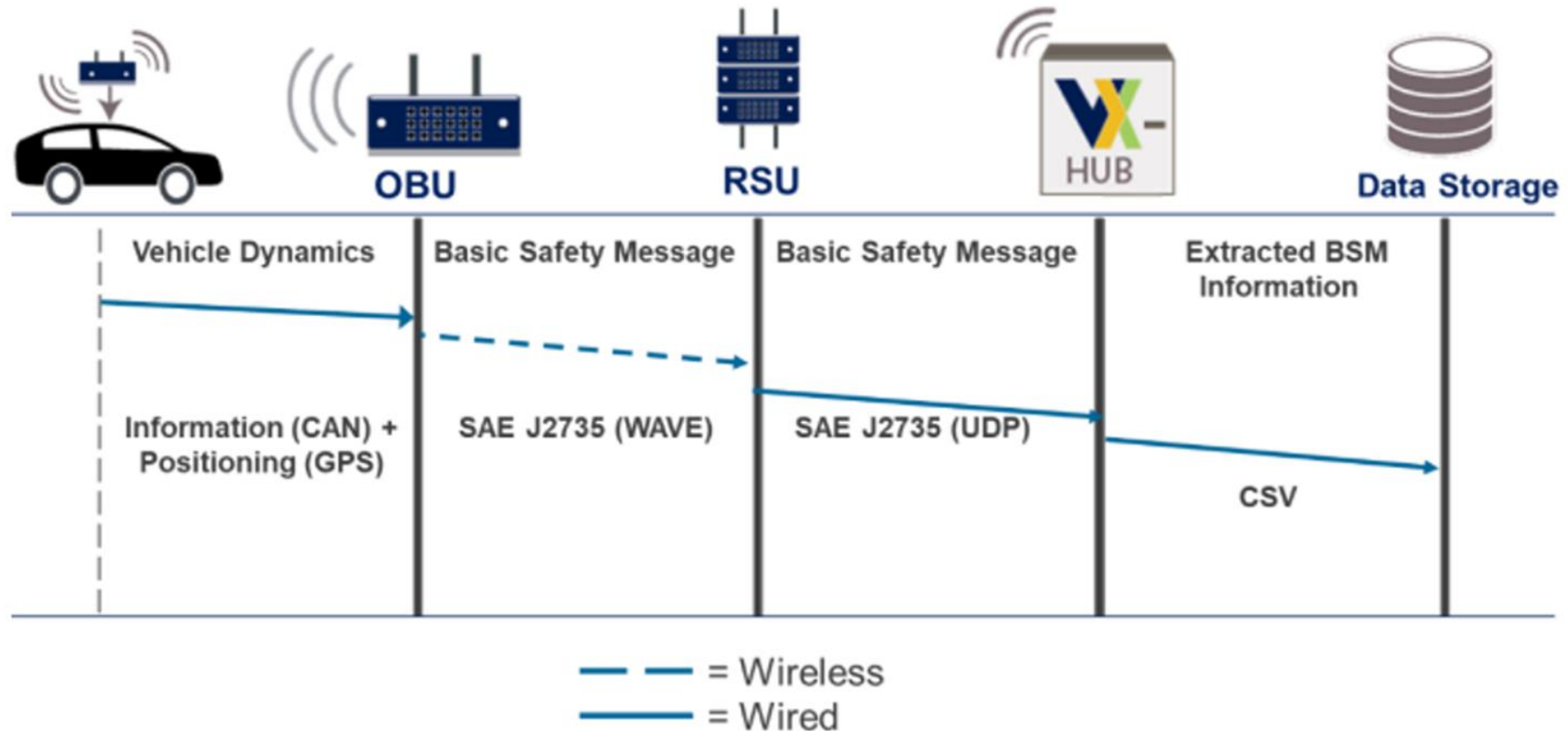


Figure 28. Diagram. BSM data flow diagram.
For the full description [click here](#).
Source: FHWA.

TRAVELER INFORMATION MESSAGE (TIM)

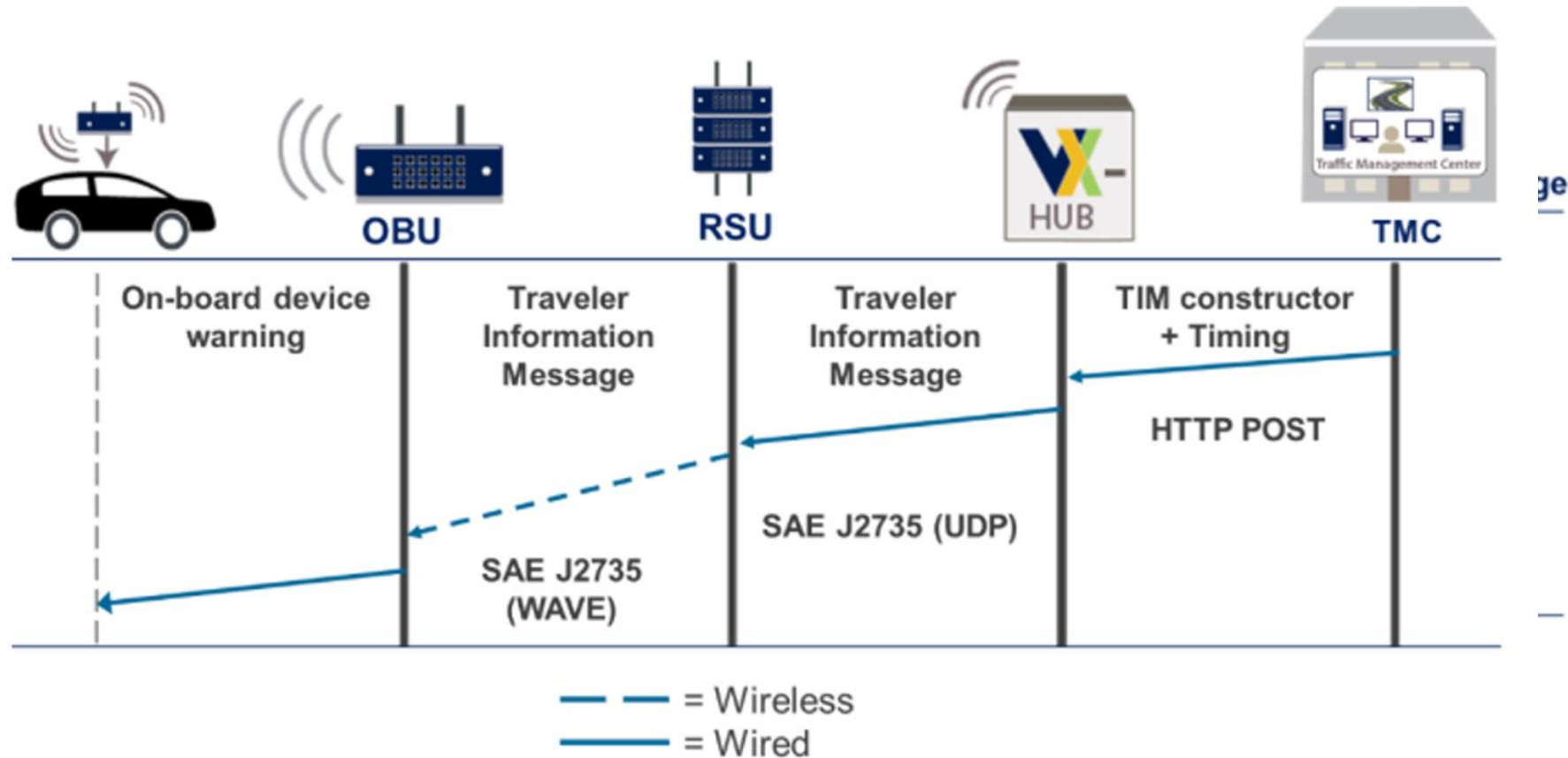


Figure 30. Diagram. TIM data flow diagram.
For the full description [click here](#).
Source: FHWA.

TRANSPORTATION SYSTEMS MAINTENANCE AND OPERATION (TSMO)

- *“A set of strategies that focus on operational improvements that can maintain and even restore the performance of the existing transportation system.”*
<https://ops.fhwa.dot.gov/tsmo/>
- Using strategies to maximize capacity and mobility on existing infrastructure with limited funds



TYPES OF TSMO STRATEGIES

- **Ramp Management**

- Work Zone Management
- Traffic Incident Management
- Special Event Management
- Road Weather Management
- Transit Management
- Freight Management
- Traffic Signal Coordination
- Traveler Information
- Congestion Pricing
- Active Transportation and Demand Management
- Integrated Corridor Management

- **Access Management**

- Connected and Automated Vehicle Deployment
- Queue end warning

- **Variable speed limits**

- Changeable lane assignment
- Freeway/arterial integrated corridor management

- **Managed lanes (high-occupancy vehicle/toll lanes)**

- **Ramp metering**

- **Traffic surveillance**

- **Traffic signal control**

- Enhanced multimodal traffic signal operations
- Emergency vehicle preemption
- Transit signal priority
- Truck signal priority
- Warning systems (queue, curve, intersection, size, and speed)
- Roadside truck electronic screening/clearance programs

- **Road weather information systems**

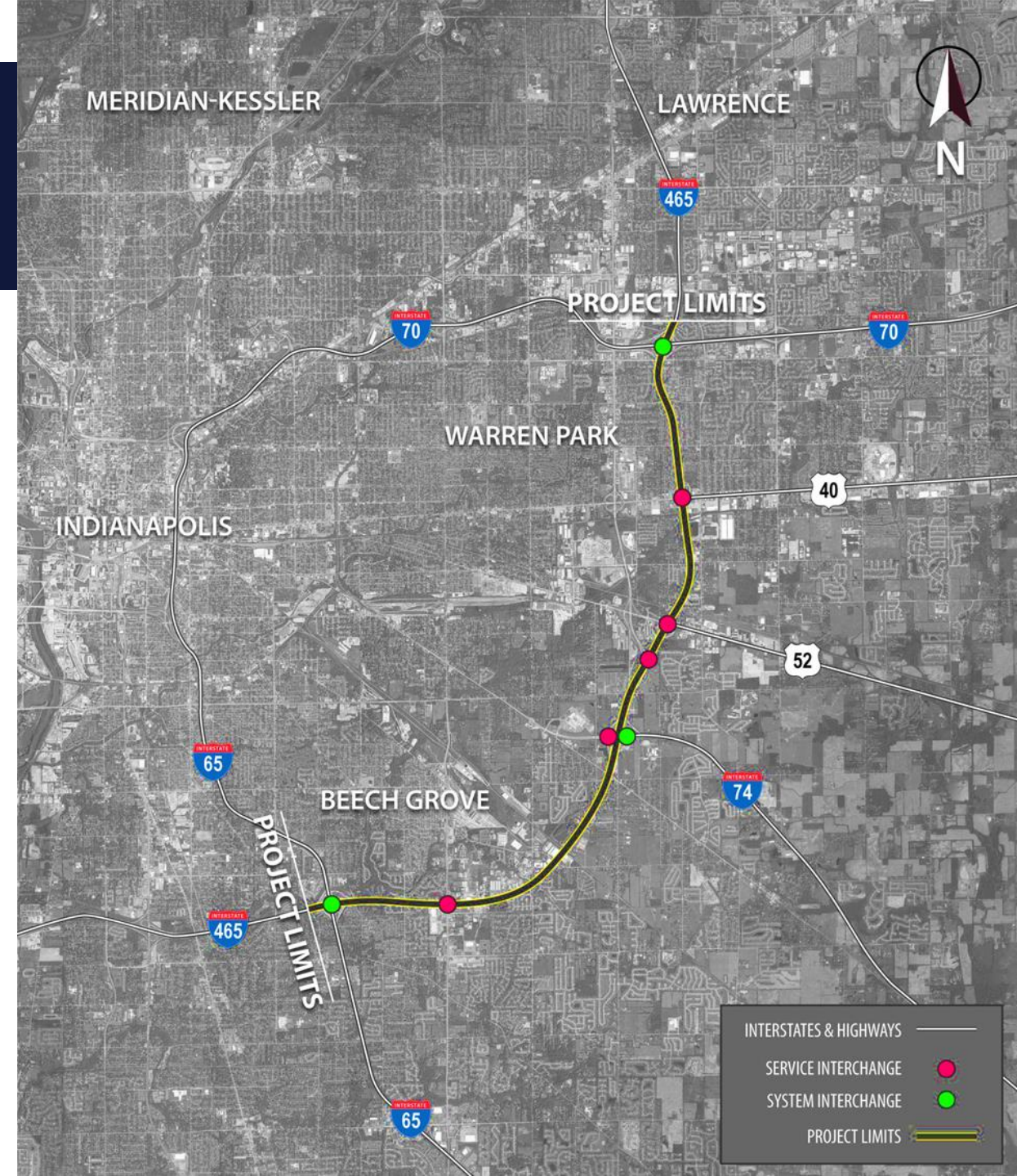
- Winter roadway operations
- Maintenance and construction Traffic incident management
- Emergency management

- Computer-aided dispatch integration
- Emergency vehicle routing
- Advanced transit operations management
- Electronic fare collection and integration
- Transit surveillance and security
- Multimodal travel connections
- High performance transit
- Dynamic Ride sharing
- Reversible Lanes
- Dynamic Junction Control
- Parking Management

- **Shoulder Riding**

I-465 SOUTHEAST TSMO PROJECT

- I-465 from I-70 to I-65
- 3 System Interchanges
- 5 Services Interchanges
- INDOT's first permanent TSMO project
- CE-4 based on new strategy in Indiana
- No Additional R/W
- VISSIM model of the corridor as a backbone
- Determined congestion and speed of the corridor
- Identify locations of high accident rates and crash patterns



IDENTIFY POSSIBLE TSMO ALTERNATIVES

ALTERNATIVES IDENTIFIED		ALTERNATIVES ELIMINATED		ALTERNATIVES CONSIDERED
Active Transportation and Demand Management (ATDM)	Improved Bicycle and Pedestrian Crossings	Access Management	Lane Control	Active Transportation and Demand Management (ATDM)
Ramp Management	Integrated Corridor Management	Active Parking Management	Predictive Traveler Information	
Traffic Signal Coordination	Lane Control	Congestion Pricing / Dynamic Pricing	Road Weather Management	
Variable Speed Limits (VSL)	Predictive Traveler Information	Connected and Automated Vehicle Deployment	Special Event Management	
Queue Warning	Road Weather Management	Dynamic Shoulder Use	Traffic Incident Management	
Access Management	Special Event Management	Freight Management	Transit Management	Ramp Management
Active Parking Management	Traffic Incident Management	Improved Bicycle and Pedestrian Crossings	Traveler Information	Traffic Signal Coordination
Congestion Pricing / Dynamic Pricing	Transit Management	Integrated Corridor Management	Work Zone Management	Variable Speed Limits (VSL)
Connected and Automated Vehicle Deployment	Traveler Information			Queue Warning
Dynamic Shoulder Use	Work Zone Management			
Freight Management				

RAMP METERING



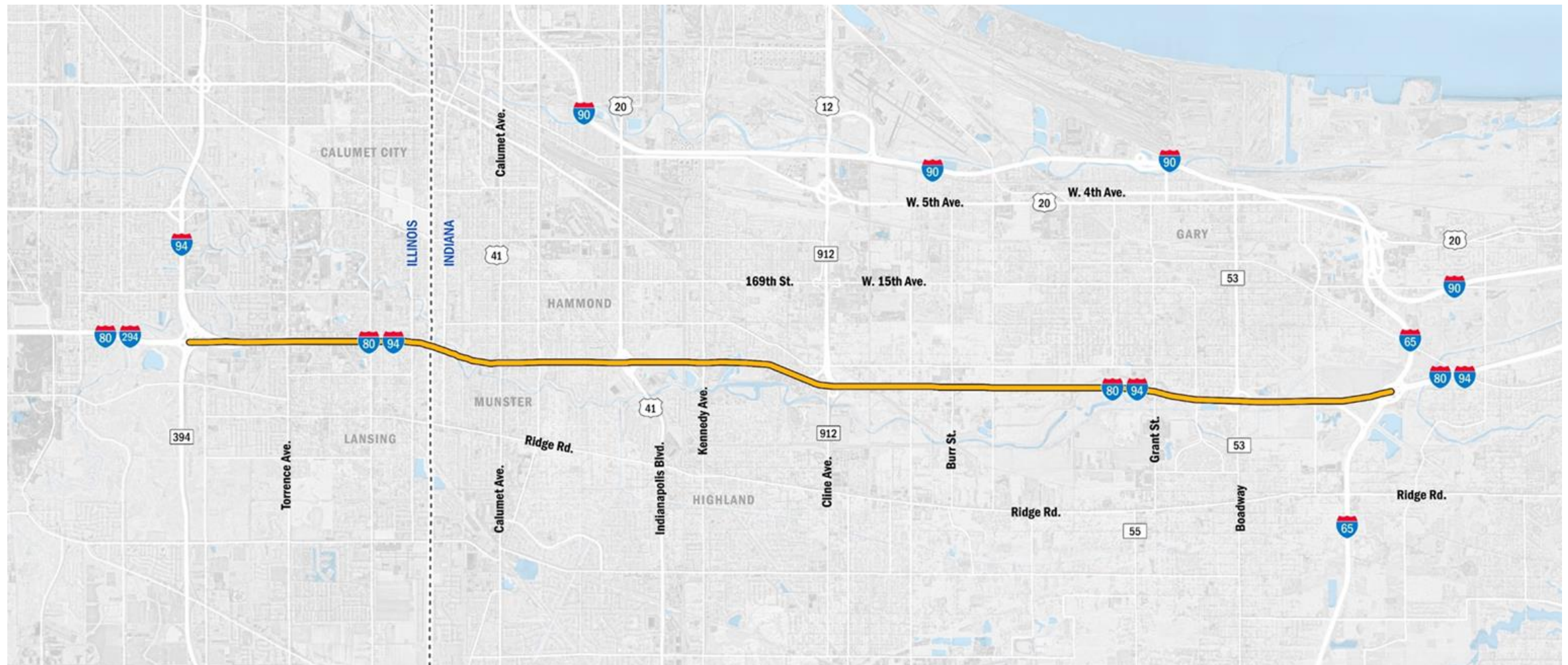
VARIABLE SPEED LIMIT (VSL) SIGNS

Variable Speed Limit “VSL” Signs for I-465 mainline



























- Spaced ~ ½ mile apart
- Located in pairs on outside and median
- Several placed on existing overhead structures
- Avoided boring conduit
- Avoided CMB replacement
- When active, speed change in 5 MPH increments
- Records of speed changes will need to be public

THE BORMAN EXPRESSWAY (I-80/94) PROJECT



ALTERNATIVE PACKAGES REVIEWED

	Dynamic Shoulder Lane	Event Management	Improved Signage	Interchange Improvements	Ramp Metering	Variable Speed	Dynamic Lane Control	Queue Warning
Alternative 1 Base Package								
Alternative 2 Base Package + Ramp Metering								
Alternative 3 Base Package + Mainline Safety Bundle								
Alternative 4 All Options								

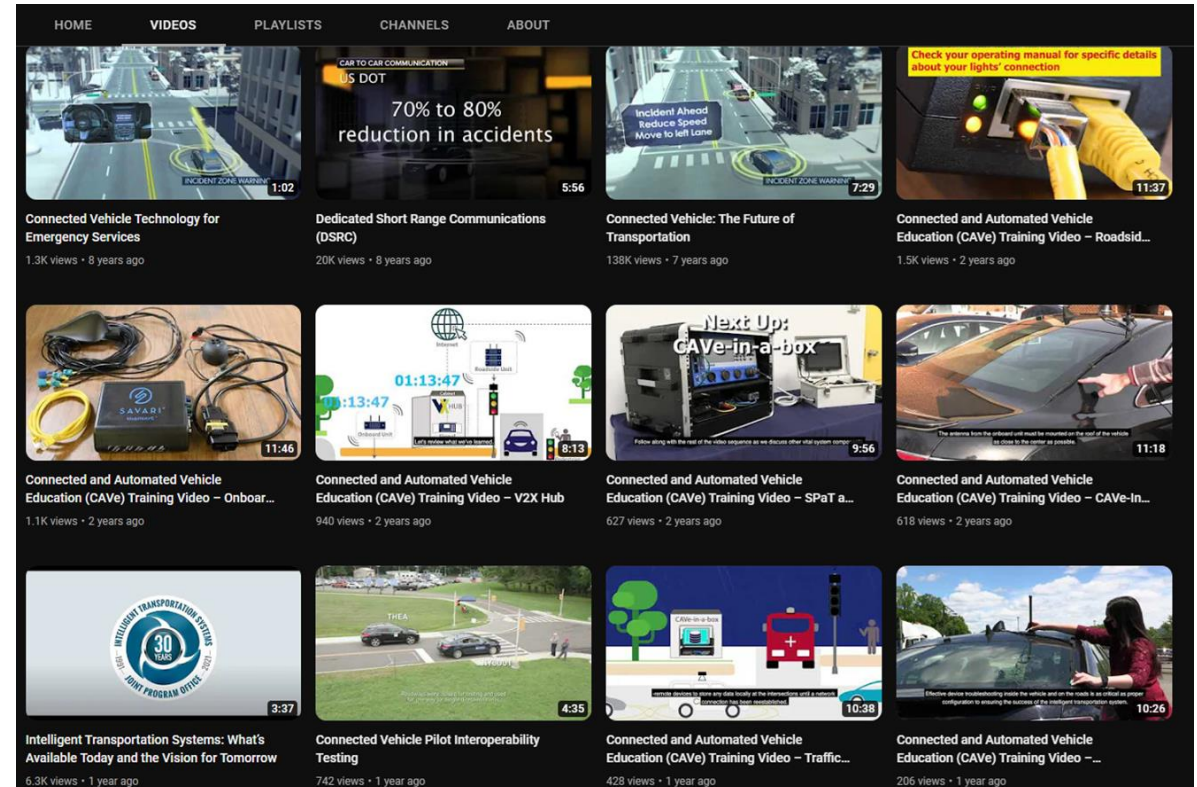
GANTRY CONCEPT - DYNAMIC SHOULDER & VSL

2A. FULL MATRIX 11' x 64' DISPLAY 3 LINES OF CENTERED SUPPLEMENTAL TEXT (NEVADA, OHIO) WALK-IN GANTRY STRUCTURE



TRAINING VIDEOS

<https://www.youtube.com/@itsjpo/videos>



FHWA documentation on TIM messages and BSM messages

https://www.pcb.its.dot.gov/CAVE/sys_design_doc/chapter5.aspx

An aerial photograph of a city street scene. In the foreground, there is a circular fountain with a central column and water. The street is paved and has several cars parked along the sides. Buildings of various styles and heights line the street, including some with arched windows and others with flat roofs. Trees are planted along the sidewalks. The overall scene is a mix of urban architecture and greenery.

**Become an engineer if you
~~— are good at math —~~
want to change the world.**

THANK YOU!

Contact ACEC Indiana:



Staff@ACECIndiana.org